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AUTHOR Freebody, Peter; Anderson, Richard C.
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ABSTRACT

Two experiments assessed the effects of text cohesion and schema availability on sixth grade children's comprehension of social studies passages that varied in vocabulary difficulty. The purpose of the experiments was to test the compensation hypothesis within the interactive theory of reading, which assumes that reading involves many complementary levels of analysis and states that when one source of knowledge about the meaning of a text element is inoperative, other sources of knowledge may provide alternative ways of determining meaning. In the first experiment, 75 sixth grade students read texts that varied in cohesion (the linguistic features contributing to the unity of a text). The analyses of free recall, summarization, and sentence verification (recognition) measures revealed no interactions between cohesion and vocabulary difficulty, although difficulty of vocabulary significantly affected students' performances on the recall tasks. In the second experiment, 82 sixth grade students read passages in which topic familiarity was varied to manipulate the availability of appropriate schemata. Familiarity with the topic and vocabulary difficulty significantly affected performance on the recall tasks, but the two factors did not interact. Thus, the results from these experiments did not support the compensation hypothesis. (RL)

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CENTER FOR THE STUDY OF READING

Technical Report No. 225

EFFECTS OF VOCABULARY DIFFICULTY, TEXT COHESION, AND SCHEMA AVAILABILITY ON READING COMPREHENSION

Peter Freebody
University of New England, Armidale

Richard C. Anderson
University of Illinois at Urbana-Champaign

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University of Illinois
at Urbana-Champaign
51 Gerty Drive
Champaign, Illinois 61820

Bolt Beranek and Newman Inc.
50 Moulton Street
Cambridge, Massachusetts 02238

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Abstract

Two experiments assessed the effects of text cohesion and schema availability on children's comprehension of social studies passages that varied in vocabulary difficulty. Free recall, summarization, and sentence verification measures were used. In the first experiment texts were prepared which varied in cohesion. No interactions between cohesion and vocabulary difficulty appeared, although main effects for vocabulary were found. In the second experiment, schema availability was manipulated by varying topic familiarity. Significant main effects for familiarity and vocabulary difficulty were found; however, the two factors did not interact. The results of the two experiments failed to support expectations based on an interactive theory of reading.

Effects of Vocabulary Difficulty, Text Cohesion and Schema Availability on Reading Comprehension

An interactive theory of reading assumes that reading involves many complementary levels of analysis. A satisfactory understanding of a particular element in a text depends, not only on accurate identification of the words, but also on a knowledge of syntax, analysis of connections between this element and other parts of the text, and prior knowledge of the topic. An interactive theory of reading gives rise to an interesting prediction which we will call the *compensation hypothesis*. This hypothesis says that when one source of knowledge about the meaning of a text element is inoperative, other sources of knowledge may provide alternative ways of determining meaning. For illustration, suppose that there are no specific cues in a text about how a certain proposition ought to be integrated into the reader's representation, perhaps because explicit connectives were removed during an overzealous application of a readability formula (cf. Davison, Kantor, Hannah, Hermon, Lutz, & Salzillo, 1980). The reader may, nonetheless, be able to figure out how to integrate the proposition if he or she has adequate word processing skills and a well-developed schema for the topic of the discourse. Thus, these sources of knowledge may compensate for the lack of connectedness of the text.

The first purpose of the research reported in this paper was to test the compensation hypothesis. In Experiment 1, texts were written that varied in cohesiveness and vocabulary difficulty. Based on the compensation hypothesis, we expected the subjects to do fairly well with texts containing a high degree of cohesion even when much of the vocabulary

was difficult. We also expected them to do fairly well with low-cohesion texts that contained easy vocabulary. The one place where a sharp decrement in performance was expected was on low-cohesion texts that contained difficult vocabulary. In Experiment 2, texts were written that varied in topical familiarity, as well as vocabulary difficulty. Expectations paralleled those for the first experiment. Fairly good performance was expected when the text involved either a familiar topic and difficult vocabulary or an unfamiliar topic and easy vocabulary. Poor performance was expected only in the case where the topic was unfamiliar and the vocabulary was difficult.

Expressing these predictions in the terminology of the analysis of variance, in addition to main effects, a vocabulary x cohesion interaction was predicted in Experiment 1 and a vocabulary x familiarity interaction in Experiment 2. These predictions depend upon a proper match between materials and subjects. If, for instance, the passages and tests turned out to be very easy, there would be no room for the interaction to show itself among high ability subjects. In other words if there were a performance ceiling, or a performance floor, a three-way interaction involving ability would be predicted.

A second purpose of the present experiments was to try to explain the confusing findings of previous research on the role of vocabulary difficulty in text comprehension. Wittrock and his colleagues (Marks, Doctorow, & Wittrock, 1974; Wittrock, Marks, & Doctorow, 1975) have reported that changing about one substance word in six to an unfamiliar synonym impairs children's performance on multiple

choice measures of text comprehension. Two instructional experiments, however, have called into question a simple interpretation of these findings. Tuinman and Brady (1974) pre-tested fourth-, fifth-, and sixth-grade students on standardized comprehension tests, and on the difficult words in these tests. They then trained the students on these words using a variety of exercises (definition, examples, use in context), and assessed both vocabulary learning and text comprehension. Vocabulary instruction resulted in an increase in students' performance on the vocabulary test by an average of about 20%, but for the comprehension measure, pre- and posttest means were almost identical. Thus, no transfer from word instruction to text comprehension was evident. Similarly, Jenkins, Pany, and Schreck (1978), using a number of instructional methods to teach word meanings to fifth- and sixth-grade students, found no ensuing benefit on tests of comprehension of texts containing the words that had been taught. Groups receiving vocabulary instruction were able to perform no better on a cloze test or in free recall than a uninstructed group which definitely did not know the words.

In the present research, we sought to determine whether variations in cohesiveness or topic familiarity could plausibly account for the inconsistent results of previous research on vocabulary knowledge. A highly cohesive text or one about a familiar topic may enable the reader to navigate around low-frequency words and search elsewhere for sufficient clues to meaning to allow the building of an adequate representation. As Jenkins and his colleagues speculated, while trying to explain why children who received direct instruction on difficult vocabulary did no better than

an uninstructed control group, "When faced with passages based on familiar themes, perhaps readers need only to detect sufficient fragments of information to recognize the theme. From this they then construct the author's intended meanings based on their own 'knowledge recipes' or schemata (pp. 29-30)."

Experiment 1

The framework for our analysis of cohesion was provided largely by Halliday and Hasan (1976). They developed a taxonomy of the linguistic features which contribute to the unity of a text. Their claim was that cohesion occurs in text when

> *the interpretation of some element in the discourse is dependent on that of another...the two elements, the presupposing and the presupposed, are thereby at least potentially integrated into a text.* (p. 2).

Their treatment consisted of a taxonomy of various types of relations or *ties*. They discussed five types of ties: (a) reference, in which an element needs, for its interpretation, to be related to another thing, class of things, place, or time; (b) substitution, where an item is replaced by another term; (c) ellipsis, in which an item is omitted but understood; (d) conjunction; and (e) lexical cohesion, in which an item is either repeated or replaced by a synonym, a superordinate, or in which a "collocation" has occurred, that is, in which lexical items are used which regularly co-occur.

A major form of cohesion is referential; that is, a word is used which cannot be interpreted in its own right, but must be evaluated in

terms of an element elsewhere in the text or in the context of the communication. Halliday and Hasan indicated three general forms of referential cohesion -- personal (*I, you*), demonstrative (*this, that*), and comparative (*some, more*).

Halliday and Hasan implied that an integrative operation is required when referential terms are used:

> *These items are directives indicating that information is to be retrieved from elsewhere...the information to be retrieved is the referential meaning, the identity of the particular thing or class of things that is being referred to: and the cohesion lies in the continuity of reference, whereby the same thing enters into the discourse a second time.* (1976, p. 31).

More precisely, cohesion lies in the assumption of continuity of reference on the part of the reader, which is the basis for the interpretation of referential terms. In simple cases of reference we might suppose that the load imposed on the reader is not substantial. When reference becomes complicated or ambiguous, we would expect additional effort to be required and the effects of unfamiliar vocabulary to be more significant.

Substitution and ellipsis function in much the same way as does referential cohesion. Halliday and Hasan related the various forms in the following way:

> *Substitution is a relation between linguistic items, such as words or phrases; whereas reference is a relation between meanings...ellipsis is...simply a kind of substitution; it can be defined as substitution by zero* (1976, p. 89).

Examples of (1) nominal, (2), verbal, and (3) clausal substitutions are:

(1) *My axe is too blunt. I must get a sharper* <u>*one*</u>.

(2) *Do you think Joe knows? Everyone else does.*

(3) *Is there going to be an earthquake? They say so.*

In ellipsis, an element is left unsaid or understood, but the "structural slot" (p. 143) is still in the sentence or clause. Halliday and Hasan gave the following example of ellipsis:

(4) *This is a fine hall you have here. I've never lectured in finer.*

These devices relate to the richness and explicitness of the local context of a proposition in a text. When the cohesion level is high, the reader can easily retrieve the relevant information and integrate it into the new proposition. The instruction to do this may be a referential, substitutive, or elliptic device, but the operation is essentially the same.

There is some research comparing children's comprehension of noun repetitions, pronouns, and ellipsis. Richek (1976-77) examined third-grade children's understanding of sentences such as the following:

(5) *John saw Mary and John said hello to Mary.*

(6) *John saw Mary and he said hello to her.*

(7) *John saw Mary and said hello to her.*

Richek found that the repeated noun form was easier to comprehend than the pronoun form, which in turn was easier than the elliptic form. This suggests that these devices do create an additional load on the reader, arising from the need to compute the intended referent and place it in the empty structural slot before interpreting the proposition.

Another characteristic of texts that is related to cohesion according to Halliday and Hasan is the use of conjunctions. Under

this heading appear single-word connectives (e.g., *and, or, so*) and connective phrases and clauses (e.g., *at once, whichever way it is*). In general, conjunctions specify the way in which following ideas are to be integrated with preceding ideas.

There is some research on the effects of the presence or absence of conjunctions on reading comprehension. As Walmsley (1977) has indicated, most of the research on conjunctions has been of a very specific kind, detailing children's understanding of particular conjunctions especially *and, or,* and *because,* and has been at the level of individual sentences. One study of the effects of the presence or absence of conjunctions on recall of texts was conducted by Hagerup-Neilsen (1977). He found that conjunctions facilitate processing for average readers and when the topic of discourse is less familiar. In another empirical study, Pearson (1974-75) found that higher cohesion, that is, the joining of propositions into longer, more explanatory sentences, led to enhanced recall.

The final type of cohesive device that is described by Halliday and Hasan is termed *lexical cohesion.* This is the cohesion signaled by the use of synonyms, superordinates, subordinates, general nouns, complementaries, and collocations. This cohesion, in other words, is signaled by vocabulary selection, rather than by structural devices. While lexical cohesion is the most difficult to specify due to the innumerable ways word meanings can be related to one another and can co-occur, it is clearly an important source of cohesion in text. It is the variable most strongly related to Halliday and Hasan's notion of the underlying thematic nature of cohesion and "texture." A text has texture when it forms an integrated semantic unit.

In the present research, low cohesiveness was introduced by downgrading referential, substitutive, and elliptical devices, and conjunctions. It is hypothesized that ties may be arranged hierarchically in terms of the burden they impose on processing. Repetition of a referential term may be supposed to entail the least processing effort, followed by common synonym substitution, pronominalization, and ellipsis. To make a text less cohesive, a referential tie was replaced by a tie at least one step lower in this hierarchy. This manipulation will be described in more detail in a later section.

A text may be made less cohesive in more subtle ways than downgrading referential ties and removing conjunctions. Kantor (1978) has examined some stylistic characteristics that can lead to difficulties in processing. These he termed instances of "inconsiderateness" on the part of a writer. They include the writer's failure to reiterate a previous proposition that is an important presupposition of the current discourse, the writer's use of implicit, unexpected, or implausible premises as linking information, and the writer's inclusion of locally tied but thematically extraneous information. An example of the last mentioned type of inconsiderateness is taken from a passage describing the nature and purpose of tariff laws: Following the statement that luxuries such as furs and perfumes are the objects of particularly severe tariffs, there is a sentence to the effect that France has always been famous for popular perfumes. A referential tie exists (the repetition of *perfumes*), and a weak lexical collocation could be in effect since trade has presumably been discussed in terms of imports from other

countries and *France* is a member of the category *other countries*. So superficially the sentence is adequately tied. However, the reader is led to process extraneous information, which perhaps causes fruitless searches of memory, or which perhaps causes the development of unfulfilled expectations. Irrelevant material in the text would, it is hypothesized, place additional burdens on the reader and hamper the development of ideas about the meanings of text segments containing unfamiliar words.

To summarize, high cohesiveness in a text is defined here as (a) repetition of important referents with the identical lexical items, rather than with substitutions, pronouns, or through ellipsis; (b) frequent use of connective words and phrases making explicit the conjunctive, disjunctive, temporal, spatial, or causal relations between the ideas; and (c) direct relevance of most information to the major points of the passage. Low cohesiveness is characterized by (a) relatively more substitutions, pronouns, and ellipses; (b) relatively fewer connective words and phrases; and (c) the presence of extraneous information. The general hypothesis is that difficult vocabulary will have minimal effects on comprehension when cohesion is high, but that, with decreasing cohesion, the effects of difficult vocabulary will become more pronounced. Operationalization of these constructs will be discussed in more detail in a later section.

Method

Subjects. Eighty-four sixth-grade students from a small city in central Illinois participated in this experiment. Four of these students did not complete the three passages in the allocated time, and

nationally standardized reading comprehension and total language ability stanine scores were not available on five others. The remaining 75 students had means of 5.96 (SD = 1.59) and 5.93 (SD = 1.61) on these two measures, indicating that this sample of students performed above the national mean on these tests.

Materials. Three passages of 250-300 words in length were chosen from the Scott Foresman Social Studies text for Grade 5. The procedure for generating high- and low-cohesion versions of the texts involved two steps. First, an even more cohesive version of the passage was written which employed as many repetitions of terms and "transparent" substitutions as possible without completely depriving the text of its stylistic quality. The first step in the generation of low-cohesion versions of passages was the downgrading of many of the ties in each text, according to the postulated hierarchy of explicitness. Thus, a repetition of a word in the original would be replaced by a less explicit tie (e.g., a pronoun or ellipsis), and so on. While attempting to avoid stilted or unduly obscure prose, the downgrading was made as strong as possible. That is, a tie would not be simply downgraded by one step on the hierarchy, but by as many steps as was felt stylistically acceptable.

The following excerpts illustrate the contrasting forms produced by this first step. High- and low-cohesion forms are presented in examples (8) and (9) respectively.

(8) *All countries have laws about how trade and business can be carried on with other countries. One of the oldest ways that governments control trade with these laws is through a "tariff" law. The tariff is most often a tax*

on goods coming into a country. The tax is added to the price of the goods and so it makes the goods cost more.

(9) *All countries have laws about how trade and business can be carried on with other countries. One of the oldest ways that governments control exchange is through a "tariff" law. This is most often a tax on goods coming into a country. It is added to their price and so makes them cost more.*

It can be seen that not all ties have been downgraded, that the results of these modifications are stylistically acceptable, and that this manipulation mainly affects local relatedness rather than the broader connectivity of the text. This latter aspect was addressed in the second step of the procedure.

The high-cohesion version of the passage was then rewritten with the addition of as many connective words (e.g., *so, because, then,* etc.) and phrases (e.g., *because of this, after that,* etc.) as style permitted. These items sometimes served to link a proposition to an immediate neighbor, and sometimes served a more global, structural purpose in the passage, linking propositions to earlier statements or to purpose. The contrast of high and low cohesion by this step is illustrated in examples (10) and (11), respectively. The statement that *governments put tariffs on goods for many reasons*, along with one such reason, appeared earlier in the text.

(10) *Another reason governments put tariffs on goods is to help a country have a good balance of trade. This means that if many people in a country are buying things from other countries...*

(11) *Often a tariff is put on goods to help a country have a good balance of trade. If many people in a society are buying things from other places...*

From these two steps, involving enhanced or downgraded lexical ties and high and low connectivity, two versions of each text were produced that were termed *high-* and *low-*cohesion form. A final step was taken to generate a third version of each passage. At each of four places in the low-cohesion form of each passage, two extraneous propositions were inserted. These were tied to an immediately preceding lexical item, usually by a repetition, but contained information that was otherwise completely irrelevant to the theme of the passage. Two illustrations are provided below, along with the immediately preceding sentences.

(12) A nation often puts a tariff on goods when it is trying to help business get started. *A business that is just getting started will often need to hire more people.*

(13) Almost every drop of rain that falls makes its way back to the oceans. It will once again be evaporated. *Rainfall is very often hard to forecast, and very often people get caught in the rain.*

This third version of each passage, containing eight irrelevant propositions, was termed the *inconsiderate* version, after Kantor (1978).

The vocabulary difficulty manipulation of one substance word in four involved substituting an unfamiliar synonym using a procedure outlined fully elsewhere (Freebody & Anderson, 1981). Reference to Carroll, Davies, and Richman (1971) revealed that all substitutions entailed substantial differences in word frequency. Thus, six versions of each passage were created involving three levels of cohesion and two levels of vocabulary difficulty.

Design and procedures. Vocabulary difficulty was a between-subjects factor, and cohesion level was a within-subject factor. The forms of

the passages containing easy and difficult vocabulary were arranged in two three-order Latin squares. Each subject read three passages, one in each cohesion condition. Order of presentation was balanced by embedded Latin squares within the larger squares. Subjects were tested in their intact class groups and were randomly assigned to the six rows of the squares. Fourteen were assigned to each row, but failure to complete the tasks or lack of standardized measures resulted in a range of 11 to 14 cases per row.

After reading each passage, the students completed a multiple-choice vocabulary item, which acted as an interval filler. They were then asked to recall the passage as fully as possible, using their own words where necessary. Upon completion of this task, they were asked to write a two- or three-sentence summary of the main ideas in the passage. The final task consisted of 13 sentence verification items, covering both important and trivial propositions from the passages. There were five each of negative and positive items. These items were selected to test specifically the effects of certain vocabulary and cohesion manipulations. Three other items were foils that obviously had no basis in the passage. The students were instructed to read each sentence carefully and to decide whether or not it expressed an idea from the passage, and to check a "yes" or "no" box accordingly.

The passages were divided into propositions, where a proposition was a clause or phrase expressing an idea for the first time in the text. For the free recall measure, students were awarded a score when the gist of a proposition was recalled. Interjudge reliability on a sample of

94 protocols was .96. Five adults summarized the passages. The students' summaries were scored on the basis of whether the propositions that appeared consistently in the adults' summaries were included. For the sentence verification measure, students scored a point if they correctly confirmed or rejected a sentence. Since there was an equal number of "yes" and "no" responses required (excluding foils), no correction for response bias was made.

Multiple regression analysis was used to partition the variance in this experiment, following the logic outlined in Cohen and Cohen (1975). The ability measure was entered first in the between-subjects portion of the analysis. This permitted a more sensitive test of the other factors included in the design. All two-way interactions were entered into the equation for each dependent measure, with the exception of the story x position effect, which is of no interest. The only three-way interactions examined were the ability x vocabulary x cohesion and the ability x cohesion x position interactions. The variance from other higher-order interactions was pooled with the residual term.

Results and Discussion

The major findings of this experiment are presented in Tables 1 and 2. Table 1 contains means. Table 2 summarizes the partitioning of variance and *F* values. In Table 2 the percentage-of-variance values refer to between- or within-subject variance, respectively. The proportion of variance due to between-subjects effects, *P*(*B*), is included at the bottom of the table. Interaction terms appear in the table only if they were significant in at least one analysis. "Group" is a nuisance factor coding

row in the Latin square; the fact that group was not significant itself and did not enter into any significant interactions means that it does not complicate the interpretation of the rest of the analysis. The passage variable was significant in all three analyses, demonstrating the effects of unspecified content factors.

Insert Tables 1 and 2 about here

Of prime interest is the interaction of word difficulty and cohesion. In this experiment, the vocabulary x cohesion interaction accounted for precisely nil variance on all three measures! If the passages (or tests) were either too easy or too difficult for a large block of the children, the expected two-way interaction might have been displaced into a three-way interaction involving ability. But this did not happen either.

As can be seen in Table 1, performance was better when the passage contained easy vocabulary, an effect that was significant in the case of the recall and summary measures but not the recognition measure. Cohesion did not have any significant main effects. However the cohesion x position interaction was significant in all three analyses. While the data were not entirely orderly, inconsiderateness tended to suppress performance in the second and, particulary, the third position. The cohesion x passage interaction was also significant in the analysis of summarization, indicating that the effects of cohesion depended upon the passage. The only other significant factor in the experiment was language ability, which had the expected positive relationship with performance on all three measures.

A detailed, proposition by proposition analysis was made of the summaries. Four propositions appeared consistently in the adult summaries of each of the passages. These are listed in Table 3 along with the proportion of children who included each proposition in their summaries. In the first passage, "Fuels," the three propositions that the children often included in their summaries form a closely knit sequence: We rely on these

Insert Table 3 about here

fuels; we are running out of them; (so) we are divising new energy sources. The rarely included proposition is stressed equally in the passage, but presumably does not relate in the same close way to possible new energy sources, the description of which takes up much of the passage.

The second passage, "Trade Laws," proved difficult for most students. Only a quarter of them managed to place the central topic, tariffs, in the general framework of a law governing international trade. One student in seven included a general definition of a tariff. The two functions of tariffs were included very rarely. The notion of balancing trade was almost never put in a summary by a student. This is a large-scale somewhat abstract idea and probably one with which students in the sixth grade are unfamiliar.

The explanation for the summaries of the third passage, "Sea," is more obscure. A possible explanation is that the statements of the ocean's importance and of our pollution of the ocean carry the strong implication that the pollution should stop. Thus, the students may have omitted it as obvious.

While no significant main effects for vocabulary or cohesion were evident on the sentence recognition measure, an item by item analysis was undertaken anyway. There were only a few items on which there were sharp differences in performance. Most of these differences could be traced to specific differences in wording between the versions of the passages containing easy and difficult vocabulary. For instance, the high-cohesion version of the Fuels passage contained the following section (difficult vocabulary in parentheses):

(15) *For centuries windmills were used to pump (propel) water and grind (pulverize) grain, but now...*

One of the test items based on this section was,

(16) *Windmills were used to crush grain for many years.*

Overall 62% of the children who received the easy version shown in (15) got this item right, whereas only 44% of the children who received the difficult version got it right.

There were few sharp differences on the sentence recognition test associated with level of cohesiveness. One exception to this generalization was the following item:

(17) *In recent times, windmills have been used to pump water.*

This item is based on the section of the Fuels passage represented in (15). In place of the *but now*, the low-cohesion and inconsiderate versions contained the word *and*, minimizing the contrast and perhaps clouding the discrimination between recent and traditional uses of windmills. Item (17) was correctly answered by 74%, 39%, and 45% of the children, respectively, who received the high-cohesion, low-cohesion, and inconsiderate versions of the passage.

It should be noted that in only a few sentence verification items did the correct answer hinge on information made explicit by a connective or clarified by a precise reference; thus, this measure may not have been very sensitive to the cohesion manipulation. Still, considering the results with the recall and summarization measures, as well as the sentence verification measure, the present experiment does not permit an escape from the conclusion that the effects of cohesion are weak.

There is previous research, such as that of Hagerup-Nielsen (1977), which indicates that lack of connectives does not seriously damage comprehension because readers are usually able to make bridging inferences. The same notion may be applied to the results of the present experiment: When a reader encounters material in which there are few cohesive ties, the attempt to integrate information from proposition to proposition continues. However, reading becomes more effortful, which may explain the interactions with position (perhaps related to fatigue) and passage (perhaps related to familiarity of content). According to this speculative account, lack of cohesion does not produce specific breakdowns in comprehension except in isolated cases. Instead, it leads to a nonspecific degradation of performance because of increased cognitive load.

Vocabulary, on the other hand, showed none of the characteristics of a load factor in this experiment. It had a consistent, direct effect on performance, showing no interactions with ability, passage, position, or cohesion levels. Plainly, when readers encounter words they do not know, there is a decrement in performance. However, this does not necessarily mean that vocabulary difficulty causes an increase in cognitive load. Our

theory is that many readers, upon encountering a word they do not know, simply skip it, avoiding a drain on resources (see Freebody & Anderson, 1981). This speculative hypothesis is based on the assumption that unknown words are very "visible" to the reader and permit rapid executive decisions. In contrast, cohesive ties, or their absence, can only be assessed for their significance after the actual processing. At the point of processing, the latter may be more "invisible" to the reader than are unfamiliar words.

Experiment 2

It has been shown that schemata embodying knowledge about the topic have strong effects on comprehension. Bransford and Johnson (1973) demonstrated an extreme case of inadequate comprehension due to a failure of a relevant schema to be activated. Some subjects received the title to a vague passage before reading it, some after, and some not at all. Bransford and Johnson found significant improvements in comprehension and recall due to prior knowledge of the topic. The title-after condition did not result in any gains over the no-title scores. They concluded that relevant knowledge must be activated prior to processing if comprehension is to occur.

A detailed study of the effects of high versus low topic knowledge was conducted by Spilich, Vesonder, Chiesi, and Voss (1979). In this study, subjects with high and low knowledge of baseball heard the description of a half-inning account of a fictitious baseball game, and then attempted to recall the text. The results indicated that the advantage for high-knowledge subjects was both quantitative and qualitative. High-knowledge subjects recalled larger amounts of information about the event and also gave a more accurate account of the sequence of information.

High-knowledge subjects recalled more text elements relevant to goals of a baseball game than did low-knowledge subjects and were more likely to elaborate on these elements and make them more graphic.

As Anderson (1977) has pointed out, the use of a relevant schema can assist at the point of comprehension specifically by clarifying ambiguous elements in a text (Anderson, Reynolds, Schallert, & Goetz, 1977; Schallert, 1976) and providing the ideational scaffolding for assimilating text information (Anderson, Spiro, & Anderson, 1978). Prior knowledge of the topic can also allow the reader, at the point of recalling text, to develop an appropriate plan for searching memory (Anderson & Pichert, 1978) and to fill in gaps or resolve inconsistencies (Steffensen, Joag-Dev, & Anderson, 1979).

When the topic is familiar, the reader has available a schema that often can serve as the basis for appropriate estimates of meaning when difficult or unknown words are encountered. When the hypotheses generated from the schema are unavailable, that is, when the topic is unfamiliar, unknown words would be expected to have a greater likelihood of leading to inaccuracies and uncertainities. The general hypothesis tested in the second experiment is that topic familiarity and vocabulary difficulty have interacting effects on measures of text comprehension.

Method

Subjects. Participating in this study were 88 sixth-grade students from a small city in central Illinois. Standardized scores were not available on six of these students. Nationally-normed stanine mean for the remaining 82 on the reading comprehension test was 6.02

(SD = 1.80), and on the total language measure, 6.07 (SD = 1.76). On these measures, then, this group of students performed above the national mean.

Materials. Four passages were constructed for this experiment. These were familiar and unfamiliar versions of two themes, a visit theme and a game theme. Each version of a theme was written in as close a form as possible to the contrasting version. The visit theme had as its familiar instantiation a visit to a supermarket, and as its unfamiliar instantiation, a trip to a Niugini sing-sing (an intervillage musical ceremony). The setting for the two instantiations was similar. In the supermarket passage, the initiating event was the request of a Niuginian family, with whom the author was staying, to explain about supermarkets. In the passage about sing-sings, the explanation is initiated by a request from the author to a Niuginian family, who was visiting the author. To convey some idea of the parallel construction of the two forms, the openings of the supermarket and sing-sing passage are provided in examples (14) and (15).

(14) *I once got to be the friend of a family who lived in the jungles of Niugini. While I was staying with them once, I happened to say that their food was much tastier than the food we Americans bought in our supermarkets. "Your what?" they asked. They had never heard of supermarkets.*

(15) *I once got to be the friend of a family who lived in the jungles of Niugini. While they were staying with me once, they happened to say that our music was much noisier than the music they made in their sing-sings. "Your what?" I asked. I had never heard of sing-sings.*

It can be seen that, while there are several necessary changes in vocabulary, there is nonetheless a high proportion of shared words, and a complete match in syntactic structure throughout the contrasting passages. The differing words, apart from the topic words, were chosen to be at approximately the same level of frequency (e.g., *tastier/noisier, carts/feathers, shopper/dancer, pay/clean*).

The game theme was developed in the same way. The familiar instantitation of this theme described the game of horseshoes and and its origins among American cowboys, while the unfamiliar instantiation dealt with an American Indian game which involved the throwing of a piece of buffalo bone, a *huta*. The preferred terrain and grips were discussed in both forms. Again, sentence structure was identical across forms, and only those words directly related to the particular instantiation were changed. Introductions to the sections on the terrain and the grips are presented in Examples 18, 19, 20, and 21.

(18) *But horseshoes could not be played just anywhere. Parts of the land the cowboys lived in were very hot and dry, so the ground would get hard and flat. This is just the way it needs to be for a good game of horseshoes.*

(19) *But huta could not be played just anywhere. Parts of the land the Indians lived in were very cold and icy, so the ground would get hard and flat. This is just the way it needs to be for a good game of huta.*

(20) *The shoe would be held in the right hand between the thumb and the other fingers. The thumb would be placed on the top of the curve of the shoe.*

(21) *The huta would be held in the right hand between the thumb and the second finger. The first finger would be placed between the two feathers on the top of the huta.*

Thus, two closely parallel pairs of passages were generated. In order to maximize control over the manipulation, only those words common to familiar and unfamiliar forms were replaced in the production of the difficult vocabulary versions.

Design and procedures. The passages were arranged such that vocabulary difficulty was a between-subjects variable. Each subject read two passages--the familiar instantiation of one theme and the unfamiliar instantiation of the other. This constituted two two-order Latin Squares, with familiarity as the within-subjects factor. Order of presentation was counterbalanced within row. Students were randomly assigned to one of the four rows of squares at the point of testing. Students participated in intact class groups. The instructions were identical to those used in the previous experiment.

Results and Discussion

Table 4 contains the means obtained in Experiment 2. Table 5 summarizes the regression analyses. Of major interest is the vocabulary x familiarity interaction. This effect was not significant on any measure, thus the expectation based on an interactive theory of reading went unfulfilled. In the case of the summarization measure, there was a significant ability x vocabulary x familiarity interaction; however, it did not take a form consistent with any version of interactive theory: High-ability subjects did especially poorly on the familiar passage containing easy vocabulary, whereas low-ability subjects did notably well on the unfamiliar passage containing easy vocabulary but very poorly on the familiar passage containing difficult vocabulary.

Insert Tables 4 and 5 about here

As can be seen in Table 4, easy vocabulary led to somewhat higher performance than difficult vocabulary on each of the three measures; however, the difference was significant only in the case of the verification measure. With respect to recall, the difference attributable to vocabulary difficulty was not significant even though it was of the same size as the differences due to position and familiarity, which were significant. The explanation is that the experiment provided a less sensitive test of vocabulary difficulty, a between-subjects factor, than position or familiarity, which were within-subjects factors.

Familiarity had the expected significant effect on recall. As indicated earlier, the influence of schemata on recall have in the past been studied in a number of ways, including selecting subjects from different cultures (Steffensen, Joag-Dev, & Anderson, 1979), selecting subjects from the same cultures who vary in amount of topical knowledge (Spilich, Vesonder, Chiesi, & Voss, 1979), or assigning subjects different perspectives (Anderson & Pichert, 1978). This experiment has added to the picture by demonstrating that passages written in parallel, with only a few of the words changed to redefine the topic as either familiar or unfamiliar, produce substantial differences in recall.

Two complementary accounts can be offered of the effects on recall of the lack of a familiar schema. One account stresses the additional effort required at the point of encoding when unfamiliar topics are involved. Ambiguous terms cannot be resolved, necessary bridging inferences are not easily made, and, in general, more effort with fewer results characterizes the encoding process. A second account places more

emphasis on the point of recall. At that point, by hypothesis, retrieval is problematical because of a lack of structured prior knowledge. Pieces of the text are retrieved, but their mnemonic value cannot be fully exploited, since connections among concepts are not obvious. Both encoding and retrieval processes may contribute to schema effects (see Anderson, Pichert, & Shirey, 1979).

On the summarization measure, there was an unexpected trend for higher performance on the unfamiliar than the familiar passages. Interpretation of the results on the summarization measures is complicated by strong theme and theme x familiarity interaction effects. A detailed examination of the students' summaries was undertaken to try to understand these results. Since the scores on the summarization measure are not absolute but reflect matches to adult performance, some consideration of the adults' summaries needs to be made. For the game theme (Horseshoes and Huta passages) the common elements across the adults' summaries were the same for the two passages. In both cases, summaries regularly mentioned the passage was mainly a description of a game, played by cowboys/Indians, with a horseshoe/buffalo bone, using a certain grip, and on a certain terrain. In the visit theme, however, the two passages (Supermarket and Niugini Sing-Sing) led to different patterns of summaries among the adults. Only two equivalent propositions were common, the fact that the listener/narrators are foreign people, and the fact that one needs to pay/clean up afterwards.

Table 6 indicates the proportion of children who included each proposition in their summaries, averaged across vocabulary conditions. In both Horseshoes and Huta, the least frequently included propositions for each

passage were those concerning grip and terrain. These are two genuinely summarizing statements: Each is superordinate to other information and encapsulates at least one paragraph. It has been found (Day & Brown, Note 1) that children use superordinate statements far less frequently than adults in forming summaries. For the Supermarket passage, students frequently described the audience and indicated that they were told about supermarkets. Sing-sing was summarized, again, by a description of the speakers and, most

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Insert Table 6 about here

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frequently, by noting that the event was somehow musical in its purpose.

Summaries for the familiar passage, Supermarket, contained three out of five propositions concerned with the elements of the narration scene (who the listeners were and their state of knowledge, the fact that they were told about supermarkets, and the effect of this description on them). A fourth proposition concerns a speaker's comment on the shopping activity (its ease). Only one proposition actually informs the reader about some concrete part of the activity (the necessity to pay). For the unfamiliar passage, however, the adults provided information descriptive of the Sing-sing ceremony in four out of the five commonly included propositions. This distinction is striking when it is recalled that macrostructurally, syntactically, and even in a large portion of the vocabulary, the two passages are identical. It seems that the noteworthy information for these readers in the familiar passage is that there were people who did not know about supermarkets, whereas what is noteworthy about the Sing-sing passage is the actual event itself. The fact that no comparable differences

were found in the comparison of adult summaries for the Horseshoes and Huta passages suggests that supermarkets may be a more taken-for-granted aspect of these adults' lives than is the game of horseshoes.

From Table 5 it can be seen that the significant predictors of performance on the sentence verification task were student ability, vocabulary condition, passage, topic familiarity, and the interaction of ability and familiarity. The means relating to the main effects are in the predicted directions. The familiarity effect accounted for a particularly large portion of the variance. With respect to the interaction there were no clear ability differences on the familiar passages, performance being uniformly high. On the unfamiliar passages, a clear ability effect was evident in the expected direction.

An item by item analysis of the sentence verification measure was conducted to examine particular effects of vocabulary difficulty and topic familiarity. From Table 7, it can be seen that Sentences 1, 4, 5, 7 and 10 display familiarity effects. It is clear that some knowledge of the horseshoe game and of supermarkets would make the correct response obvious. Sentence 4 has no direct paraphrase in either form of the theme. It is stated toward the end that the "best player would be the winner," but in neither story is it stated what constitutes good play. As predicted, virtually all of the readers of the Horseshoes passage could correctly infer that distance was not the criterion, while less than two-thirds of the students reading the Huta passage were able to reject the idea that nearness (to an unspecified object) is what made a good throw.

Insert Table 7 about here

The clearest case of a familiarity effect seems to be Sentence 7. A basic idea in shopping is that you pay, once only, for what you want. Only one student out of the 41 who read the Supermarket passage was unable to reject the notion of paying twice. The equivalent item in the Sing-sing passage, however, was rejected by about half of the students in this condition. The inability to reject glaring anomalies seems related to one's prior knowledge of the topic.

Difficult vocabulary seemed to add to the problems of students reading unfamiliar passages on Sentences 2, 3, and 8. In these cases it is clear that some facilitation due to topic familiarity was operating for those students reading familiar passages with difficult vocabulary. It should be noted that for Sentence 8 a general effect of familiarity is also evident.

For Sentences 6 and 9 an advantage is evident for familiar passages with easy vocabulary. In Sentence 9 the parallelism across familiarity conditions is not complete--it is not clear that the Sing-sing is a physically easier task than listening to the radio. Thus, the finding of interest is the advantage of easy over difficult vocabulary conditions within familiar form. A general effect for difficult vocabulary is suggested by Sentence 6, but the advantage is comparatively small.

The sentence verification task has highlighted some specific effects of familiarity. Items were observed in which difficult vocabulary suppressed performance just when the topic was unfamiliar, but the overall

interaction effect did not account for variance. Notable was the decreased ability of subjects reading unfamiliar passages to reject anomalous statements.

General Discussion

The results of these two experiments failed to support the hypothesis that when one source of knowledge about the meaning of a text element is degraded, other sources of knowledge may compensate and provide alternate ways of determining meaning. We searched in vain for interactions that would have supported the compensation hypothesis. Experiment 1 failed to produce any interactions between vocabulary difficulty and text cohesion, and Experiment 2 did not yield interactions between vocabulary difficulty and topic familiarity. These findings are not the ones that would be expected on the basis of an interactive point of view about reading, though it should be noted that no extant theory is irrevocably committed to the compensation hypothesis. No doubt a clever person could reformulate interactive theory to save it from the unfulfilled prediction.

On each of three measures in the two experiments, performance was lower when the passages contained difficult vocabulary, and in half of these cases the effect was significant. Perhaps the important point that should be emphasized, though, is that it takes a surprisingly high proportion of difficult vocabulary to produce reliable decrements in comprehension measures. Thus, our experiments (see also Freebody & Anderson, 1981) suggest that it is probably a mistake to interpret the high correlations always seen between vocabulary tests and general tests of reading proficiency

indicating that word knowledge is of overriding instrumental importance in text comprehension (see Anderson & Freebody, 1981).

Experiment 2 provided another demonstration of the important role played by a reader's schema, manipulated in this case by varying topic familiarity. Among passages on the same general theme which had identical structure and syntax, and very similar vocabulary, the more familiar version was better recalled.

Earlier we tried to explain the weak and inconsistent effects of cohesion in Experiment 1 in terms of the speculative hypotheses that lack of cohesion leads to nonspecific, and therefore hard-to-measure, degradation of performance because of increased cognitive load. An alternative possibility is that cohesion, in the specific sense of linguistic ties, simply is not very important in reading. Morgan and Sellner (1980) have argued that the linguistic basis for the concept of cohesion is tenuous and that the body of examples that purportedly support the concept is unconvincing. Indeed, they conclude that, "As far as we can see, there is no evidence for cohesion as a linguistic property, other than as an epiphenomenon of coherence of content" (p. 181). The attempt was made in Experiment 1 to manipulate cohesion without disturbing content. If Morgan and Sellner are correct, it is not surprising that this manipulation had little influence on performance.

Reference Note

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Table 1

Mean Performance as a Function of
Vocabulary Difficulty and Cohesion

Factor	Recall	Summarization	Sentence Verification
Vocabulary			
Easy	5.9	1.0	6.8
Difficult	4.0	.8	6.5
Cohesion			
High	5.0	.9	6.7
Low	5.0	1.0	6.6
Inconsiderate	4.7	.8	6.5

Table 2

Partitioning of Variance and Significance Tests for Three Measures

Source	df	Recall		Summarization		Verification	
		% Variance	F	% Variance	F	% Variance	F
Between-Subjects							
Ability	1	14.3	14.24**	19.2	19.30**	26.76	27.85**
Group	4	5.6	1.38	8.7	2.19	6.18	1.61
Vocabulary	1	12.8	12.60**	5.5	5.58*	2.61	2.71
Residual	67	67.4	---	66.5	---	64.38	---
Within-Subject							
Passage	2	35.2	38.16**	21.8	21.50**	14.4	12.51**
Position	2	2.1	2.23	4.7	4.62*	.8	<1
Cohesion	2	.2	<1	3.0	2.94	.7	<1
Cohesion x Position	4	4.7	2.55*	6.1	3.02*	12.0	5.21**
Cohesion x Passage	4	3.4	1.83	5.2	2.56*	4.9	2.13
Residual	117	53.9	---	59.3	---	67.3	---
P(B)		.57		.46		.58	

*p < .05
**p < .01

Table 3

Proportion of Students Including Propositions in Summaries

Proposition	Proportion
Fuels	
We rely on fuels such as petroleum, etc.	.40
These are dangerous to the environment.	.08
We are running out.	.37
People are trying to devise new sources. (e.g., windmills, etc.)	.29
Trade Laws	
There are laws governing trade (e.g., tariffs).	.26
Tariffs are taxes on imports and exports.	.15
Tariffs earn the government money.	.07
Tariffs help balance trade.	.03
Sea	
The sea is vast and important.	.43
Its animals and plants are vital in the life system.	.18
It is being polluted.	.34
People are attempting to stop this.	.30

Table 4

Mean Performance as a Function of

Vocabulary Difficulty and Topic Familiarity

Factor	Recall	Summarization	Verification
Vocabulary			
Easy	9.0	2.0	7.7
Difficult	7.1	1.7	7.0
Familiarity			
Familiar	8.7	1.7	8.7
Unfamiliar	7.2	2.0	5.9

Table 5

Partitioning of Variance and Significance Tests for Three Measures

Source	df	Recall		Summarization		Sentence Verification	
		% Variance	F	% Variance	F	% Variance	F
Between-Subjects							
Ability	1	17.4	17.12**	5.1	4.55*	6.7	6.08*
Group	3	2.9	<1	9.1	2.72	.4	<1
Vocabulary	1	3.3	3.29	2.3	2.09	8.4	7.57**
Residual	75	76.2	--	83.4	--	83.0	--
Within-Subject							
Theme	1	.1	<1	28.8	36.87**	2.0	3.34
Position	1	9.9	7.79**	nil	<1	.7	1.24
Familiarity	1	7.7	6.03*	6.1	7.83**	50.8	86.08**
Theme x Familiarity	1	1.9	1.50	12.3	15.77**	1.0	1.75
Ability x Familiarity	1	.2	<1	.2	<1	7.5	12.67**
Ability x Familiarity x Position	1	2.2	<1	5.1	6.51*	1.3	2.19
Residual	55	69.8	--	42.9	--	32.5	--
P(B)		.73		.66		.55	

*p < .05

**p < .01

Table 6

Proportion of Students Including Propositions in Summaries

Proposition	Proportion
Horseshoes	
Concerns a game.	.76
Played by cowboys.	.46
Horseshoe is used.	.22
Grips described.	.12
Necessary terrain described.	.12
Huta	
Concerns a game.	.95
Played by Indians.	.83
Bone from buffalo used.	.46
Grips described.	.02
Necessary terrain described.	.22
Supermarket	
Listeners were native people (unfamiliar with supermarkets).	.68
They were told about supermarkets.	.49
They were told how easy it was to shop there.	.12
Necessary to pay (difficult).	.20
The listeners were impressed	.07
Niugini Sing-Sing	
Main purpose was musical.	.71
Music was impromptu.	.17
They dressed up.	.10
Necessary to clean up (difficult).	.12
Speakers were native people (listener was unfamiliar with Sing-Sings)	.37

Table 7

Mean Number of Correct Verifications

Sentence	Familiar		Unfamiliar	
	Easy Vocabulary	Difficult Vocabulary	Easy Vocabulary	Difficult Vocabulary
Game Theme				
1. The stake (track) for the shoes (bones) is an important part of the game.	10.0	9.1	7.9	7.3
2. The cowboys (indians) would often make up [designate] two teams.	9.5	9.6	8.4	6.4
3. The surface needs to be sloping and grassy for a successful [good/adequate] game.	9.0	8.6	9.5	5.9
4. The one who could throw it furthest (closest) was the winner.	9.0	10.0	6.8	5.6
5. Each cowboy (indian) would have to make four or five of these (hutas) before the game.	6.8	7.3	2.6	4.6
6. The nails (marrow) ought not to be removed.	7.4	5.0	4.7	5.6

Table 7 Continued

Sentence	Familiar		Unfamiliar	
	Easy Vocabulary	Difficult Vocabulary	Easy Vocabulary	Difficult Vocabulary
7. You pay twice for everything you have selected. (You choose a section twice as big as your dance ring to clean up.)	10.0	9.6	4.7	5.9
8. I was visiting [staying with/sojourning with]a Niugini family once. (A Niugini family was visiting me once).	10.0	9.6	6.3	2.7
9. They said that hunting trips sounded very easy [leisurely]. (I said that listening to the radio sounded very easy.)	10.0	6.8	6.3	4.6
10. All the different sorts of food (dancers) are mixed up together.	8.4	8.6	6.3	6.4

Note: Substitutions in unfamiliar versions are in parentheses. Vocabulary substitutions are included in brakets.